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Social Facilitation: Differential Recall of Paired-
Associates as a Function of Socially Induced Arousal,
Repetition, and Retention Interval

A Thesis
Presented to the
Department of Psychology
and the
Faculty of the Graduate College
University of Nebraska

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts
University of Nebraska at Omaha

by
Gary J. Platt
April, 1977

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THESIS ACCEPTANCE

Accepted for the faculty of the Graduate College,
University of Nebraska, in partial fulfillment of the
requirements for the degree of Masters of Arts, University
of Nebraska at Omaha.

Thesis Committee

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Abstract

Predictions based on Cottrell's learned drive extension of Zajonc's hypothesis of social facilitation were investigated in a 2 X 2 X 2 factorial design. Sixty-four male subjects were shown a paired-associate list once or three times and then tested for recall either 2 min. or 45 min. later. Arousal at the time of learning was manipulated by the experimenter either closely observing or not observing subjects. After one learning trial, precisely the same form of Arousal X Retention Interval interaction found by Geen (1973) was obtained: Observed subjects recalled fewer items at 2 min. than did unobserved subjects, while contrary to Cottrell's hypothesis, this relationship reversed at 45 min. ($p < .05$). After three trials, no significant differences were found, although the means (higher for observed subjects tested at 2 min. and 45 min.) were in the direction predicted by Cottrell's hypothesis.

The influence of the presence of others upon individual behavior is of fundamental importance to numerous and diverse social phenomena. Zajonc (1965, 1966) has suggested that an audience has a single effect upon behavior: an increase in the probability of the emission of the dominant response. The variable of the audience was placed in the context of the Hull-Spence behavior theory (e.g., Spence, 1956). The presence of passive spectators supposedly increases an individual's general drive (D) level, which enhances the emission of dominant responses. When the dominant response is the correct one, as is the case in well-learned habits or instinctual activities, then performance is improved; if the dominant response is an incorrect one, as is the case for novel learning situations, then performance will suffer.

Studies have confirmed Zajonc's predictions (e.g., Cottrell, Wack, Sekerak, & Rittle, 1968; Zajonc & Sales, 1966). Using a pseudorecognition task in which verbal habits of different strengths were put into competition with each other, these studies found that the responses governed by the strongest verbal habits were facilitated when two spectators were present. In addition Cottrell et al., (1968) introduced an experimental condition in which the "spectators" present were blindfolded (allegedly to dark-adapt for an experiment in color perception); thus, the "spectators" were not able to assess

the accuracy of the subject's responses to the visual stimuli. This condition did not enhance the emission of dominant responses.

Cottrell (1968, 1972) modified Zajonc's hypothesis that the mere presence of others is a sufficient condition for producing audience effects upon performance, by proposing that the presence of others is a learned source of drive. He suggested that the drive-increasing property of the presence of others is created through social experience rather than the result of an instinctual drive, as Cottrell submits Zajonc's hypothesis implies. Cottrell concluded that the anticipation of positive or negative outcomes for the individual (evaluation apprehension) is the necessary condition for the enhancement of dominant responses.

The results of subsequent studies (e.g., Good, 1973; Gore & Taylor, 1973; Henchy & Glass, 1968; Laughlin & Jaccard, 1975; Paulus & Murdoch, 1971; Sasfy & Okun, 1974) also support Cottrell's revision. These studies varied the extent to which subjects perceived that their performance was being evaluated. In addition, Gore and Taylor (1973) and Sasfy and Okun (1974) treated the composition of the audience as an independent variable. The collective results of these studies apparently demonstrate that significant performance decrements or increments occur in evaluative conditions relative to nonevaluative

conditions across various types of audiences; dominant responses were enhanced only in evaluative conditions.

Virtually all of the studies purporting to deal with social facilitation, however, have introduced tests of performance at only one or more of the following times: just prior to, at the same time, or shortly after the subject was exposed to the audience. One exception is a study by Pessin (1933). Subjects learned a list of paired-associate (PA) nonsense syllables alone, or with the experimenter observing, to the criterion of one perfect recitation. They returned 1, 2, or 3 days later and relearned the original list under the same conditions. The results indicated that subjects in this novel learning situation learned best when alone, which is consistent with the Zajonc-Cottrell hypothesis. Retention, however, was greater for lists learned under the audience condition. The recall of apparently subordinate (correct) responses was enhanced 1-3 days later. Alternatively though, it can be argued that the initial extra number of practice trials which were required for one perfect recitation, produced these discrepant results.

A series of studies beginning with Kleinsmith and Kaplan (1964) have employed relatively long temporal periods between the time of acquisition and subsequent recall. The results of the Kleinsmith and Kaplan (1964) study indicated that high-arousal PA nonsense syllables

were significantly less available for recall at 2 min. than were their low-arousal counterparts. Furthermore, by as soon as 45 min. the relationship was reversed, due to a significant improvement in recall of high-arousal items and a significant decline in recall of low-arousal items.

Support for the Kleinsmith-Kaplan finding has come from studies in which arousal has originated from non-social sources as well as a social source, i.e., the observation of a subject by the experimenter (Deffenbacher, Platt, & Williams, 1974; Geen, 1973). The striking feature of these studies is the Arousal X Retention Interval interaction.

Geen (1973) used female subjects who were given a single presentation of a PA (nonsense syllable-digit) list and then tested for recall at 2 min. or 45 min. later with the experimenter observing. In one learning condition (No Observation), the experimenter sat at a desk and began studying some papers. In another condition (Observation), the experimenter stood just behind the subject as the list was presented. At 2 min. after exposure to the list subjects who had not been observed recalled significantly more digits than those who had. Geen also found that the mere physical presence or absence of the experimenter during learning did not affect recall. Deffenbacher et al. (1974) replicated the above

study using male subjects. Precisely the same form of Arousal X Retention Interval interaction found by Geen (1973) and Kleinsmith and Kaplan (1964) was obtained.

The Deffenbacher et al. (1974) and Geen (1973) studies support the notion that social facilitation (or social inhibition) is most likely to occur when the individual defines others as an observing and thus evaluative audience, as Cottrell's learned drive extension would suggest. The results of recall at 2 min. support Cottrell's revision of Zajonc's hypothesis. Clearly, the dominant responses in these single-trial learning studies are incorrect, and accordingly these responses were enhanced at the 2 min. retention interval.

While it is evident that the results of recall at short retention intervals support Cottrell's contentions, the results of recall at 45 min. directly contradict his revision of Zajonc's hypothesis. At this interval, only subordinate (correct) responses were enhanced. This discrepancy warrants the assumption that additional variables may be operating with respect to longer-term aspects of the effects of an arousing audience on an individual's performance. Since most real world applications of audience effects would primarily be concerned with these longer-term and more permanent results, it is important to distinguish these from the shorter-term, and perhaps transitory effects. For these reasons the present

study uses a longer-term measurement (i.e., at 45 min.) in some conditions and a shorter-term measurement (i.e., at 2 min.) in the other conditions.

In general the present experiment is a replication of the Deffenbacher et al. (1974) and Geen (1973) studies with one additional condition: Half the subjects are exposed to three learning trials instead of all subjects engaging in a single learning trial. This additional manipulation is employed to determine arousal effects on relatively better-learned PAs. The inclusion of better-learned items provides a more complete test of the Zajonc-Cottrell hypothesis than studies using only single-trial learning. The dominant responses for these better-learned items should more likely be correct responses, while the dominant responses for single-trial learning items should more likely be incorrect responses. A significant main effect for the number of learning trials will indicate the success of the dominance manipulation.

According to Cottrell's learned drive extension of Zajonc's hypothesis, under conditions of increased drive, dominant responses are enhanced. The following hypotheses are derived from this theory at the retention interval of 2 min.:

1. In Single-Trial learning, aroused subjects will recall fewer correct responses than subjects in a less aroused or more quiescent state. Specifically, the mean

number of correct digits recalled in the Observation condition will be less than in the No Observation condition.

2. In Multiple-Trial learning, the relationship will reverse; aroused subjects will recall more correct responses than subjects in a less aroused state. Specifically, the mean number of correctly recalled digits in the Observation condition will be greater than in the No Observation condition.

Contrary to the Zajonc-Cottrell hypothesis and consistent with the aforementioned studies in the Kleinsmith-Kaplan tradition, a third hypothesis is advanced at the retention interval of 45 min.:

3. In Single-Trial learning, aroused (observed) subjects will recall significantly more digits than less aroused (unobserved) subjects.

If the second hypothesis is confirmed, then there is no empirical basis known to the author for predicting differential forgetting over a 45 min. interval with regard to Observation or No Observation conditions, thus:

4. In Multiple-Trial learning at 45 min., aroused subjects will recall significantly more digits than less aroused subjects.

By definition, if hypotheses 1 and 3 are confirmed, then there will be a particular type of Observation (Arousal) X Retention Interval interaction. Yet this

interaction is possible even if hypotheses 1 and 3 are not confirmed; hence, a more conservative hypothesis is advanced:

5. Within the Single-Trial condition, there will be a significant Observation X Retention Interval interaction. No specific shape of interaction is predicted.

6. By definition, if hypotheses 2 and 4 are confirmed, there will fail to be a significant interaction in the Multiple-Trial conditions.

7. By definition, if hypotheses 5 and 6 are confirmed, there should be a significant Observation (Arousal) X Degree of Response Learning (Trials) X Retention Interval interaction.¹

Method

The design of the present study is a 2 X 2 X 2 factorial, with factors representing (a) the number of learning trials (1 trial or 3 trials), (b) the presence or absence of observation during learning (Observation or No Observation), and (c) retention intervals (of 2 min. or 45 min.). Sixty-four male volunteer introductory psychology and sociology students served in exchange for extra course credit and payment of \$1 each. The subjects were randomly assigned ($n=8$) to each of the resulting eight cells. The study was conducted by a male experimenter.

In general, the procedure was like that of the Deffenbacher et al. (1974) and Geen (1973) studies.

The experimental room was furnished with a table bearing a memory drum, a chair, and a desk. It was explained that the experiment involved either (a) "single-trial learning" or (b) "multiple-trial learning," and the subject was informed that he would be shown a paired-associate (PA) list (once or three times) and then be tested later for recall. The subject was instructed to turn on the memory drum on a signal from the experimenter and to turn it off when the word stop appeared in the drum's window. When the drum was turned on, the experimenter either (a) stood just behind the subject's right shoulder as the list was presented or (b) sat at the desk with his back to the subject and began studying some papers.

After the subject turned on the memory drum, 10 sec. elapsed before the first stimulus term appeared. The stimulus terms were ten 0% association value consonant-vowel-consonants: the same six used by Deffenbacher et al. (1974), Geen (1973), and Kleinsmith and Kaplan (1964), and four additional syllables selected from Glaze (1928), randomly paired with the digits 0-9.² Each syllable first appeared alone for 1.5 sec., followed by a 1.5-sec. blank interval before the appearance of the next syllable. The word stop appeared one blank interval after the last syllable-digit pair for the appropriate

(1 or 3) number of trials. The experimenter then escorted the subject to a waiting area and informed him of the time (2 or 45 min.) that he would have to wait; the retention interval was timed from the moment the subject was seated. To discourage rehearsal activity, all groups completed a very brief attitude survey on higher education (see Appendix A); subjects in the 45 min. conditions also attempted to complete and score the Kuder Preference Record Vocational, presumably as part(s) of a pilot study for another experiment (see Appendix B).

When the retention interval was complete, the experimenter led the subject back to the experimental room and tested him for recall with the experimenter present and observing (Geen, 1973, found that the presence or absence of experimenter observation at the time of testing did not affect recall³). Each syllable, in the same order as the study trial(s), appeared for 1.5 sec. followed by a 3.0 sec. blank interval during which the subject recited the digit previously paired with it. After the test trial, the experimenter queried the subject to discover whether the experimental deceptions had been successful and then fully debriefed the subject.

Results

No subject reported (a) awareness of the true nature of the study or (b) PA rehearsal attempts during the retention interval.

An analysis of variance revealed that the predicted second-order interaction (hypothesis 7) was marginally significant, the Trials X Observation X Retention Interval, $F(1, 56) = 3.90, p < .07$. A main effect for Trials was highly significant, $F(1, 56) = 23.49, p < .001$, indicating a higher degree of response learning for Multiple-Trial subjects. No first-order interactions or other main effects approached significance. Analyses of simple interaction effects revealed the predicted significant Observation X Retention Interval interaction with Single-Trial learning (hypothesis 5), $F(1, 56) = 6.67, p < .05$. A simple main effects analysis showed a significant difference between Single-Trial, No Observation subjects tested at 2 min. and 45 min., $F(1, 56) = 4.02, p < .05$, with subjects forgetting more digits at 45 min. No other simple interactions or main effects were significant (see Appendix C for complete analysis of variance summary table).

Figure 1 shows the eight treatment means for digit recall. Failure of the seemingly large differences

 Insert Figure 1 about here

between simple main effects at Single-Trial learning to attain significance is for the most part a function of an inflated three-factor error term ($MS = 4.36$) arising mainly from high score variability at Multiple-

Trial learning (see Appendix C, raw scores). To provide continuity with previous studies (i.e., Deffenbacher et al., 1974; Geen, 1973), F ratios were again calculated for the simple main effects using the appropriate Single- or Multiple-Trial error components ($MS = 2.06; 6.67$, respectively).⁴

Analyses of Single-Trial learning with the appropriate two-factor error term yielded significance for all of the simple main effects. As predicted (hypothesis 1), unobserved subjects recalled more digits than observed subjects at 2 min., $F(1, 28) = 4.78, p < .05$, while (hypothesis 3) at 45 min. observed subjects recalled more digits than unobserved subjects, $F(1, 28) = 6.83, p < .05$. Furthermore, the performance of observed subjects at 45 min. significantly improved compared to 2 min., $F(1, 28) = 4.37, p < .05$, and the performance of unobserved subjects worsened over the same period, $F(1, 28) = 8.78, p < .01$.

Use of the appropriate two-factor error term at Multiple-Trial learning revealed no significant differences ($F_s < 1$ in each case) for simple main effects, even though the means were in the expected direction (hypotheses 2 and 4). There was also an absence of an interaction (hypothesis 6).

Discussion

In the early stages of learning before correct responses become dominant, the Zajonc-Cottrell social

facilitation theory predicts arousal worsening performance when competing response tendencies are present. Such was found to be the case for observed vs. unobserved subjects tested at 2 min. The relative position of the means, however, significantly reversed at 45 min. despite there being no evidence for differential amounts of rehearsal during the 45 min. interval. Because the precise form of the Arousal X Retention Interval interaction obtained after a single learning trial directly replicates the findings of Deffenbacher et al. (1974) and Geen (1973), it seems to be a stable result.⁵ The significant decline in recall at 45 min. compared to 2 min. for low-arousal items is typical of the usual forgetting function. Implicit in the Zajonc-Cottrell theory, which does not discuss Retention Interval as a determinant of audience effects, is the prediction that although performance may worsen at longer retention intervals (e.g., at 45 min.) compared to shorter retention intervals (e.g., at 2 min.), the performance of observed and unobserved subjects should not alter differentially over time. However, the recall of PA items for observed subjects tested at 45 min. significantly improved compared to 2 min. performance levels. This dramatic shift in performance at 45 min., which is apparently not due to rehearsal, is thus, unaccountable in terms of the Zajonc-Cottrell theory.

It is clear that after a single learning trial, more items must have been originally stored than were retrieved at 2 min. and that arousal inhibited short-interval retrieval. Yet it is much less obvious why observation during learning produced a reminiscence effect over time and a performance superior to unobserved subjects at 45 min.

Apparently the only hypothesis that has been offered to explain the Arousal X Retention Interval interaction occurring after a single learning trial, is Walker's (1958, 1967) action decrement theory. This neurophysiological theory asserts that high arousal leads to a rapidly reverberating perseverative trace, resulting in greater long-term memory, and greater temporary inhibition against recall (action decrement) due to the rapid reverberations during the process of consolidation. Low arousal is presumed to enhance recall at brief intervals and worsen performance later because the lower initial rates of reverberation eventually result in a poorly consolidated trace. Walker's theory is consistent with the present study's findings in Single-Trial learning, as well as other studies in the Kleinsmith-Kaplan tradition.

Since each successive repetition of a stimulus-response pair in a PA list can be conceived as adding an increment in habit strength, and correct response

tendencies become dominant in the later stages of learning, then arousal should facilitate superior performance after multiple learning trials, according to the Zajonc-Cottrell theory. That Multiple-Trial PA responses were better-learned than Single-Trial responses in the present study is evidenced by the highly significant main effect for Trials ($p < .001$).⁶

While all of the means are in the expected direction, recall of the better-learned responses (after three learning trials), was not significantly enhanced by the higher level of arousal due to observation at 2 min. or 45 min. The low number of subjects per cell ($n=8$) notwithstanding, it is not clear why greater differences did not emerge, especially since observation produced marked effects after a single learning trial. A clue, however, may be provided by the differential duration of observation. Multiple-Trial subjects were observed (or not observed) longer than Single-Trial subjects (280 sec. vs. 100 sec., respectively) due to the time taken by two additional learning trials. Perhaps the additional 3 min. allowed for some degree of adaptation to the observing experimenter, lessening apprehension prior to the completion of the third learning trial, thereby minimizing arousal differences between observed and unobserved Multiple-Trial subjects. Use of a physiological or psychological index of arousal and uniform periods of

exposure to the observing experimenter for both single and multiple learning trials might have allowed a more sensitive test of hypotheses 2 and 4.

The use of more than three learning trials for Multiple-Trial conditions might have also allowed a more sensitive test of hypotheses 2 and 4, but the resulting rise in PA response strength would create ceiling effects in Multiple-Trial conditions within the present study's methodology. Thus, alternative methodologies may be necessary for future studies to investigate the effects of arousal on well-learned responses at short- and longer-term retention intervals.

The effect of multiple (and massed) trials on Arousal and Retention Interval can also be examined in terms of Walker's action decrement theory. Walker (1958, 1967) suggests that during consolidation of the memory trace, there is a negative bias against repetition of items, since repetition, like arousal, leads to higher levels of neural reverberation. Under learning conditions of high arousal, this situation is further accentuated.

 Insert Figure 2 about here

Action decrement theory then, predicts an Arousal X Retention Interval interaction after multiple learning trials similar to the prediction after a single learning trial. Figure 2 shows the eight treatment means and the

predictions from Walker's theory. Multiple-Trial observed and unobserved subjects should recall less items at 2 min. and more at 45 min. compared to Single-Trial observed and unobserved subjects, respectively. (Note that Walker's predictions for each of the four Single-Trial groups are identical to the treatment means.)

Contrary to the predictions of Walker's theory, inspection of the means in Figure 2 shows that observed and unobserved Multiple-Trial subjects recalled more items at 2 min. than observed and unobserved Single-Trial subjects. Moreover, the relative position of the means (2 min. retention interval) are reversed after three trials compared to a single learning trial. The finding that repetition increases recall performance even at short intervals is consistent with most available data (e.g., Osborne, 1972, Exp. 1; Tulving & Madigan, 1970).

The results after three learning trials at 45 min. are more consistent with Walker's predictions. While neither observed or unobserved group showed Walker's predicted reminiscence effect, at least neither group significantly declined from their respective 2 min. performance levels. Further examination of the Multiple-Trial means in Figure 2 shows that observed subjects recalled slightly more items than those unobserved, and both groups performed better than either Single-Trial

group at 45 min.

Just as the Zajonc-Cottrell theory of social facilitation fails to consider differential effects of a long and short retention interval in the investigation of audience effects, Walker's action decrement theory suffers from a failure to recognize the role that habit strength, i.e., the functional dominance of a response, plays in multiple massed trials at brief retention intervals.

In sum, the significant interaction of arousal and retention interval at one learning trial, taken with the marginally significant finding that arousal, degree of response learning, and retention interval all interact, suggests that the sole use of brief retention intervals (e.g., 2 min.) cannot be recommended. After multiple learning trials, dominant responses were found to be enhanced at 2 min., although not significantly. However, the findings at 45 min. show that socially induced arousal at the time of learning, although not significantly affecting multiple-trial recall, can improve performance after a single learning trial, independent of the functional dominance of responses.

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Footnotes

¹Logically, the conditional statement of hypothesis 7 is necessarily correct only if errorless data is assumed (see pp. 130-138 of Myers, 1973).

²Using only six PAs, a pilot study revealed a strong ceiling effect for subjects tested for recall at 2 min. after engaging in three learning trials. Thus four additional PAs were selected to allow the opportunity for the expression of measurable differences in recall.

³It is not yet apparent why Geen (1973) failed to find differences in PA recall due to Observation vs. No Observation at the time of testing. Geen's negative results at the time of testing are particularly perplexing among those subjects previously unobserved at the time of learning, since other experiments, e.g., studies employing a pseudorecognition task (i.e., Cottrell et al., 1968; Zajonc & Sales, 1966), which introduced observation at the time of testing only, have found significant performance differences.

⁴In effect, this manipulation simply treats the 2 X 2 X 2 factorial design as (2) 2 X 2 factorial designs. The consequence of such an analysis makes possible a direct comparison at Single-Trial learning between the results of the present study and those of the Deffenbacher et al. (1974) study. This analysis is also similar to

Geen's (1973) use of post-hoc t tests to investigate the simple main effects of an analysis of variance.

⁵Since Retention Interval is a between-subjects variable in the present study as well as in the aforementioned studies in the Kleinsmith-Kaplan tradition, it cannot necessarily be inferred that a given subject's performance at one retention interval will predict his performance at the other interval.

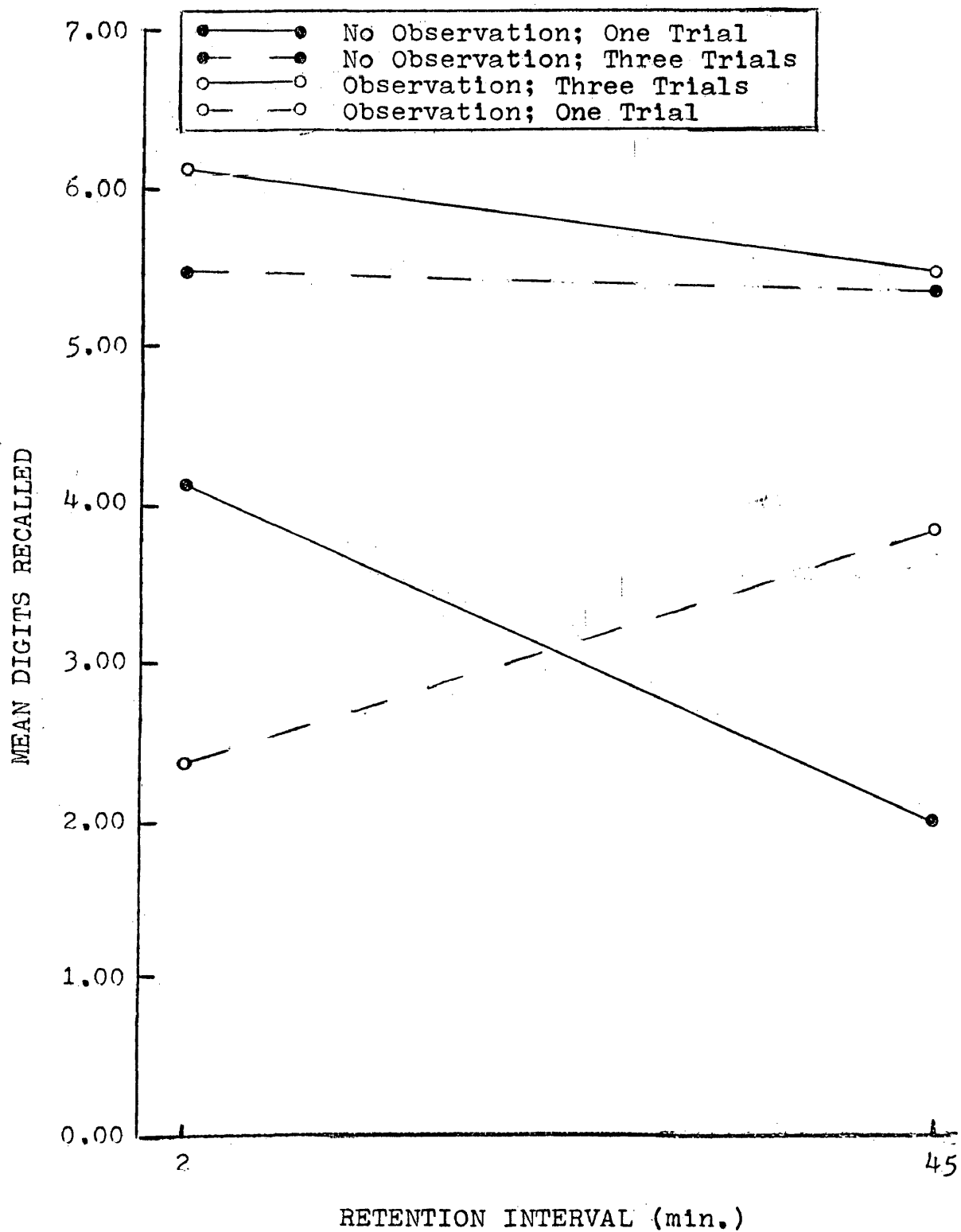
⁶Yet Osborne (1972, Exp. 2) found that the passage of time (2½ min. vs. 5 min.) apparently affected recall more than a second learning trial of high- or low-arousal lists of PAs. After one trial and after one trial plus a 2½ min. interpolation period (to equalize the time taken by an additional trial), the mean percentages for low- and high-arousal recall reversed (23.4 vs. 14 to 14 vs. 23.4, respectively). Could the time difference between one and three learning trials (3 min.) significantly affect Single-Trial recall in the present study? Since repetition and the passage of time are confounded, sixteen additional subjects were assigned to two post-experimental groups (n=8) to control for the passage of time. The procedure was the same as for Single-Trial subjects tested at 2 min., except that the controls were tested at 5 min. One control group was observed; the second was not. The results indicated only very slight differences between

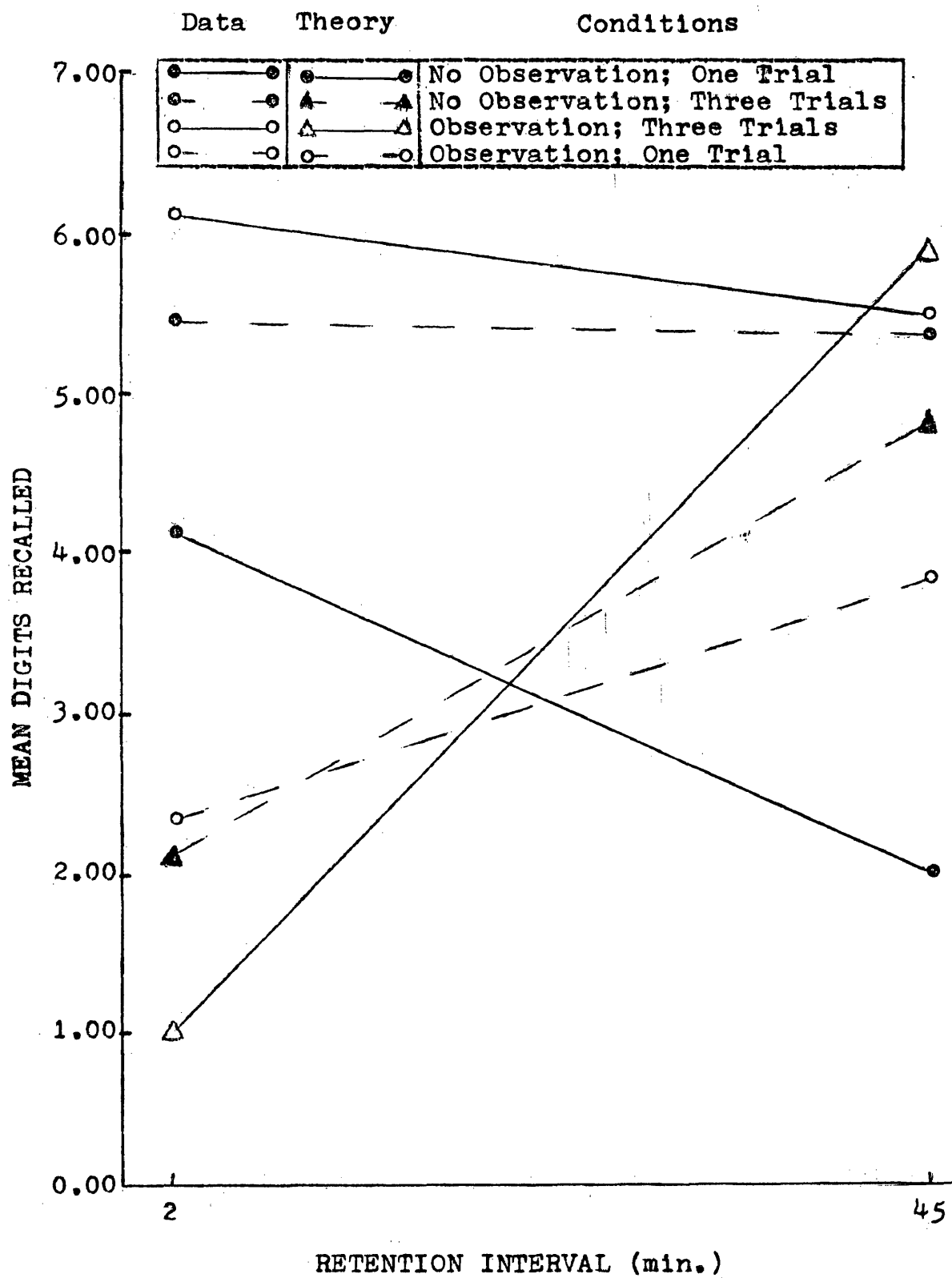
the means of subjects observed at 2 min. and at 5 min. (2.375 vs. 2.250) and those unobserved at the same intervals (4.125 vs. 3.625). Two-tailed t tests indicated no difference in either case, $t(14) = .072$, $p > .9$; $t(14) = .247$, $p > .8$, respectively. Thus the highly significant main effect of Trials in the present study was due to repetition of learning materials rather than the passage of the brief interval of 3 min.

Figure Captions

Figure 1. Mean number of digits correctly recalled for treatment groups over 2 min. and 45 min. retention intervals.

Figure 2. Mean number of digits correctly recalled and Walker's theoretical predictions for treatment groups over 2 min. and 45 min. retention intervals.





Appendix A

Attitude Survey

All subjects were asked to complete the following attitude survey which was handed to them the moment the subject entered the retention room:

Biographical Data

Age: _____ Sex: _____ College Major: _____

Educational Goal (e.g., BA, BS, MA, MS, PhD) _____

Currently Employed As: _____

Proposed Occupation Upon Completion of Degree: _____

Race: _____ One Parent's Highest Completed Level of

Education: _____ Your Present Level of Education

Using the following scale, what is your attitude towards each of the following statements:

Strongly	Moderately	No Opinion	Moderately	Strongly
Disagree	Disagree		Agree	Agree

1	2	3	4	5
---	---	---	---	---

- _____ 1. Most college students use college as a "cop-out" to delay employment and responsibility.
- _____ 2. A trade or business school offers more advantages than a college or university.
- _____ 3. Higher education plays a primary role in the solving of social problems.

- _____ 4. College better equips a student for employment
than a trade or business school.
- _____ 5. The importance of a college education is over-
rated.
- _____ 6. College students are entitled to be respected.
- _____ 7. College makes a person more mature.
- _____ 8. A college education is necessary to obtain a
high-paying job.
- _____ 9. College does little to increase the prestige of
an individual.
- _____ 10. Everyone that is able should go to college.
- _____ 11. College is a waste of time for getting ahead
economically.
- _____ 12. There are too many individuals graduating from
college to make a degree meaningful.
13. What do you think is the single most important reason
an individual attends college? _____

14. What do you think is the single most important result
of a college education? _____

Appendix B

Instructions to 45 min. retention subjects

All subjects tested for recall at 45 min. were given the following instruction sheet and the materials mentioned therein upon entering the retention room:

Subjects: Please REMAIN SEATED UNTIL THE EXPERIMENTER RETURNS and carefully follow these instructions.

1. Complete the attitude survey: the "Biographical Data" section and questions 1-14.
2. Complete the Kuder Preference Record Vocational. Begin by carefully reading the page marked "INSTRUCTIONS" in the Test Booklet, the green and gray bound booklet.
3. Reread that page.
4. Be certain the "Answer Pad" is placed in the Test Booklet immediately following the last test booklet page entitled "Put answers in Column 12."
5. Use the metal stick pin to punch the appropriate holes through the "Answer Pad." (WATCH YOUR FINGERS!)
6. Begin work.
7. When every question has been answered, remove the "Answer Pad" from the Test Booklet, turn the "Answer Pad" over, and carefully read and follow the

"DIRECTIONS FOR SCORING."

8. When scoring has been completed, carefully follow the instructions on the PROFILE SHEET.

DON'T WORRY ABOUT TIME. You are not expected to complete all tasks before the experimenter returns.

Appendix C

Raw scoresA = Number of Trials ($A_1=1$; $A_2=3$)B = Observation (B_1 =No Observation; B_2 =Observation)C = Retention Interval ($C_1=2$ min.; $C_2=45$ min.)

<u>A₁</u>				<u>A₂</u>			
<u>B₁</u>		<u>B₂</u>		<u>B₁</u>		<u>B₂</u>	
<u>C₁</u>	<u>C₂</u>	<u>C₁</u>	<u>C₂</u>	<u>C₁</u>	<u>C₂</u>	<u>C₁</u>	<u>C₂</u>
3	1	2	4	9	5	6	3
4	0	1	4	1	1	7	7
7	5	2	7	4	4	3	5
4	1	3	4	6	9	5	3
3	2	2	2	10	5	8	5
3	2	3	3	9	5	6	8
6	4	4	4	3	7	5	4
2	1	2	2	2	2	2	2
ΣY 33	16	19	31	44	43	49	44
\bar{Y} 4.13	2.00	2.38	3.88	5.50	5.38	6.13	5.50

Control groups for the passage of time

Control 1 (One trial, No Observation; 5 min. Retention Interval) - - 3, 5, 3, 2, 5, 2, 5, 4. $\Sigma Y=29$; $\bar{Y}=3.63$

Control 2 (One trial, Observation; 5 min. Retention Interval) - - 5, 3, 2, 3, 1, 2, 0, 2. $\Sigma Y=18$; $\bar{Y}=2.25$

Analysis of variance summary table

<u>SV</u>	<u>df</u>	<u>SS</u>	<u>MS</u>	<u>F</u>
A	1	102.5156	102.5156	***23.49
B	1	.7656	.7656	<1.00
C	1	1.8906	1.8906	<1.00
AB	1	.3907	.3907	<1.00
AC	1	.0157	.0157	<1.00
BC	1	9.7657	9.7657	2.24
ABC	1	17.0155	17.0155	*3.90
S/ABC	<u>56</u>	<u>244.3750</u>	4.3638	
Total	63	376.7344		
<hr/>				
BC at A ₁	1	26.2813	26.2813	**6.02
BC at A ₂	1	.5000	.5000	<1.00
B at A ₁ , C ₁	1	12.2500	12.2500	2.81
B at A ₁ , C ₂	1	14.0625	14.0625	3.22
C at A ₁ , B ₁	1	18.0625	18.0625	**4.14
C at A ₁ , B ₂	1	9.0000	9.0000	2.06
B at A ₂ , C ₁	1	1.6250	1.6250	<1.00
B at A ₂ , C ₂	1	.0625	.0625	<1.00
C at A ₂ , B ₁	1	.0625	.0625	<1.00
C at A ₂ , B ₂	1	1.6250	1.6250	<1.00
<hr/>				

*F_{.10} (1, 56) = ~2.80**F_{.05} (1, 56) = ~4.02***F_{.001} (1, 56) = ~12.20

Analysis of simple main effects with appropriate two-factor error terms

<u>SV</u>	<u>df</u>	<u>SS</u>	<u>MS</u>	<u>F</u>
S/BC at A ₁	28	57.6250	2.0580	
S/BC at A ₂	28	186.7500	6.6696	

Using the appropriate above error term, all of the simple main effects at A₁ are significant, i.e.,

B at A ₁ , C ₁	*4.75
B at A ₁ , C ₂	*6.83
C at A ₁ , B ₁	**8.78
C at A ₁ , B ₂	*4.37

Using the appropriate above error term, all of the simple main effects at A₂ remain insignificant ($F_s < 1$ in each case).

$$*F_{.05} (1, 28) = 4.20$$

$$**F_{.01} (1, 28) = 7.64$$